OCCURRENCE OF BIRTH DEFECTS NEAR KELLY AIR FORCE BASE (SAN ANTONIO, TEXAS) AMONG DELIVERIES IN 1997-2001

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BACKGROUND

Agency for Toxic Substances and Disease Registry Health Assessment

In response to public concern, the federal Agency for Toxic Substances and Disease Registry (ATSDR) conducted a health assessment of three zip codes near Kelly Air Force Base; the report was released for public comment in August 1999. Birth defects were assessed among deliveries from 1990-1995 using vital records for both the three zip code area of interest and the comparison population (the State of Texas). Based on infant death certificates only, significant excesses were found in zip code 78237 for the categories "bulbus cordis anomalies and anomalies of cardiac septal closure" (ICD-9 code 745), "other congenital anomalies of the heart" (ICD-9 code 746), and "other congenital anomalies of the circulatory system" (ICD-9 code 747).

Texas Birth Defects Monitoring Division Report

In September 1999, the Texas Birth Defects Monitoring Division was asked to study birth defects occurrence in the same three zip code area using more accurate data from the Texas Birth Defects Registry. All available data were used for this analysis (1997 deliveries). There was no excess observed in the three broad categories found to be significantly elevated in the original ATSDR report. There were significant excesses of several other broad categories of birth defects. However, the relevance of this was questionable because of the variety of defects within the categories, the absence of recurring patterns, and the susceptibility of those defects to diagnostic and reporting biases.

In the same report, a second approach broadened the geographic area to include all zip codes completely or partly within one mile of Kelly AFB. The three broad categories of heart or circulatory defects were not elevated in this area either. We also examined birth defect categories which we expect would be more uniformly diagnosed and reported across the State. There were no significant elevations noted.

PURPOSE OF THE CURRENT STUDY

Determine if residence around Kelly Air Force Base was associated with increased occurrence of birth defects among deliveries in 1997-2001, compared with elsewhere in Bexar County.

Improvements over previous studies included:

- using five years of Texas Birth Defects Registry data instead of one;
- examining a wider variety of specific birth defects;
- instead of using zip codes (which can be large and vary over time), using distance of one mile from the residence at delivery to the nearest boundary of Kelly AFB;
- also considering residence over a "plume" of groundwater contamination;
- minimizing the influence of maternal age, maternal race/ethnicity, and maternal education on the results.

METHODS

A "case" for this study had to meet the following criteria:

- delivery in 1997 through 2001 inclusive (five years);
- mother's residence at delivery was in Bexar County;
- mother's residence at delivery could be geocoded (that is, could be assigned latitude and longitude using Geographic Information Systems software);
- each case had at least one of the 49 specific birth defects routinely reported by the Department of State Health Services, or any monitored birth defect.

Geocoding was successful for 97.2% of the case addresses in this urban county. Applying all the selection criteria above resulted in 3,892 cases (infants or fetuses with one or more birth defects).

Based on the geocoded address, it was determined whether each case was born to a woman whose residence was within (less than or equal to) one mile of the borders of Kelly AFB and whether the residence was over a "plume" area of reported groundwater contamination. The location and extent of the plume was based on several studies conducted by the ATSDR, and was provided digitally by the San Antonio Metropolitan Health District (see Fig 1). Although the ATSDR studies indicated the surficial aquifer was not a likely source of exposure to residents, the plume analysis was specifically requested by the SAMHD and we included that analysis in this report.

In 1997-2001, there were 117,961 live births (based on the birth certificate residence having Bexar County or the residence address being in a Bexar County census tract).

Prevalence was calculated the usual way for birth defects, to be expressed as cases per 10,000 live births:

$$\frac{\text{cases of defect X}}{\text{live births}} \times 10{,}000$$

Statistical comparisons of prevalence used prevalence ratios calculated with Poisson regression in SAS. A prevalence ratio of 1.00 indicates that prevalence at birth (or occurrence) of the birth defect is the same in both areas compared (such as within one mile vs greater than one mile from Kelly AFB). If the ratio is less than 1.00, then the characteristic (living within one mile of Kelly AFB) is associated with lower risk of the birth defect; if the ratio is greater than 1.00 then the characteristic is associated with a greater risk of the birth defect. There is always variation of the ratio due to chance; 99% confidence limits are calculated to account for that. If 1.00 does not fall between the lower confidence limit (LCL) and the upper confidence limit (UCL), then that prevalence

ratio is unlikely to have arisen by chance alone. However, if you are calculating 50 prevalence ratios it is like flipping a coin 50 times, and you would expect (100% - 99%) or 1% of the ratios to have confidence limits that exclude 1.00. Combining Tables 1 and 3 of the current analysis, we would expect (1% x 100 ratios) or 1 ratio to be statistically significant just because we are making so many comparisons.

Using Poisson regression, we adjusted for three demographic variables based on information in the birth or fetal death certificate (or Birth Defects Registry if vital records data was missing):

- maternal age — categorized as less than 20, 20-34, 35 or older;
- maternal race/ethnicity — White non-Hispanic, African American, White Hispanic, Other/Unknown;
- maternal education — less than high school, high school, more than high school.

Poisson regression was also used to test for trend with distance by treating the three distance categories as a continuous variable. In other words, it tested whether the prevalence of having children with birth defects was greatest among mothers living within 1/2 mile of Kelly AFB, in the middle among mothers living greater than 1/2 mile to 1 mile away, and least among mothers more than 1 mile away.

RESULTS

Distance From Kelly Air Force Base

Of the 50 birth defect categories examined without adjustment, only pyloric stenosis was statistically significantly associated with living within one mile of Kelly AFB (bolded in Table 1). However, when the effects of maternal age, race/ethnic group, and education were eliminated, that was no longer statistically significant. On the other hand, both tricuspid valve atresia/stenosis and agenesis/aplasia/hypoplasia of the lung became statistically significant after adjustment for those demographic factors.

For those three defects, prevalence was compared between mothers living more than one mile away versus (a) mothers living 1/2 mile or less, and (b) living greater than 1/2 mile to one mile (Table 2). This was to see if mothers living closer to the air force base had higher risk. Pyloric stenosis and agenesis/aplasia/hypoplasia of the lung exhibited a statistically significant increase in unadjusted prevalence with greater proximity to Kelly AFB (i.e. p values for trend less than 0.01). The trend for tricuspid valve atresia was not statistically significant.

Residence Over the Plume Area

Before adjustment for demographic factors, none of the 50 birth defect categories examined was statistically significantly associated with living over the reported plume of groundwater contamination. After adjustment, Down syndrome was more prevalent among mothers living over the plume area (Table 3).

Residence Within One Mile and Over the Plume Area

Was there higher risk associated with living within one mile of Kelly AFB and living over the plume than either separately? This was examined for each birth defect that had a statistically significant prevalence ratio in Tables 1 or 3 (tricuspid valve atresia/stenosis, agenesis/aplasia/hypoplasia of the lung, pyloric stenosis, and Down syndrome). Small numbers of cases in the different areas hindered the analysis. No defects showed a significantly low p value (less than 0.01) for living both within 1 mile and over the plume, as well as significantly low p values for each effect separately (Table 4).

DISCUSSION

Among deliveries in 1997-2001, pyloric stenosis was more prevalent among offspring of mothers living within one mile of Kelly Air Force Base compared to Bexar County mothers living greater than one mile from Kelly. This association was based on 24 cases living within one mile. It may be partly explained by maternal age, race/ethnicity, and education since the association became nonsignificant after adjustment for those factors. However, the prevalence of pyloric stenosis increased with increasing proximity to Kelly AFB.

Agenesis/aplasia/hypoplasia of the lung was higher in offspring of mothers living within one mile of Kelly compared to those living greater than one mile away, and this was not explained by the demographic factors listed above since it was significant after adjustment. This finding was based on eight cases living within one mile. Within the mile, prevalence also increased in mothers living closer to Kelly.

While adjusted prevalence of tricuspid valve atresia/stenosis seemed to be higher among mothers within one mile of Kelly vs others, this did not seem to be greatest in mothers living within 1/2 mile. Lack of such a "dose response" pattern casts doubt on the idea that proximity to the air force base caused the increased prevalence of this birth defect. Five mothers of cases with this birth defect lived within one mile of Kelly AFB.

The prevalence of Down syndrome was statistically higher in offspring of mothers living over the reported plume of contaminated groundwater after adjustment for maternal age, race/ethnicity, and education. This was based on 16 mothers of cases living over the plume. However, it is unlikely that residents of the area had any access to this shallow contaminated aquifer since fewer than 5% of the households over the plume used well water as their water source.

There were 100 independent comparisons made in Tables 1 and 3. Using 99% confidence limits, we would have expected (1% x 100 comparisons) or one comparison to appear as "statistically significant" by chance alone. Four such comparisons were found to be "statistically significant"; while this is more than we would expect from chance, we don't know which comparisons are truly meaningful and thus need to consider other aspects of the results. Of those four comparisons, the biological plausibility of a relationship of the plume with Down syndrome is low. Tricuspid valve atresia/stenosis exhibited higher adjusted prevalence in mothers living within one mile of Kelly AFB, but failed to show a dose-response relationship. Pyloric stenosis showed a dose-response relationship, but might be partly explained by different demographic characteristics in mothers living within a mile of Kelly AFB vs those living further away.

Based on this study, the excess occurrence of agenesis/aplasia/hypoplasia of the lung in mothers living within one mile of Kelly AFB vs those living further away was probably the most meaningful association, since it was not explained by demographic characteristics and exhibited a dose-response pattern.

There were several limitations to this study. (A) While the most relevant address to use would be mother's residence around the time of conception (since most birth defects occur within eight weeks of conception), we were only able to use mother's residence at delivery (about 38 weeks after conception) and we know that roughly 32% of mothers in Texas move during pregnancy. That would make it harder to find any association between birth defects and proximity to Kelly AFB or residence over the plume. (B) Despite compiling five years of data from the Texas Birth Defects Registry, there were small numbers of cases living within one mile of Kelly AFB or within the plume area. This was particularly true for tricuspid valve atresia/stenosis and for agenesis/aplasia/hypoplasia of the lung. The small numbers limited the ability to identify differences in prevalence should any truly exist. On the other hand, small numbers are highly variable and could also lead to prevalence figures that appear different; confidence intervals about the prevalence ratios help account for that. (C) Residential proximity is a crude substitute for exposure to anything potentially emanating from Kelly AFB. This study could say nothing about whether or not there was exposure to any chemicals during this time period.

GLOSSARY OF BIRTH DEFECTS

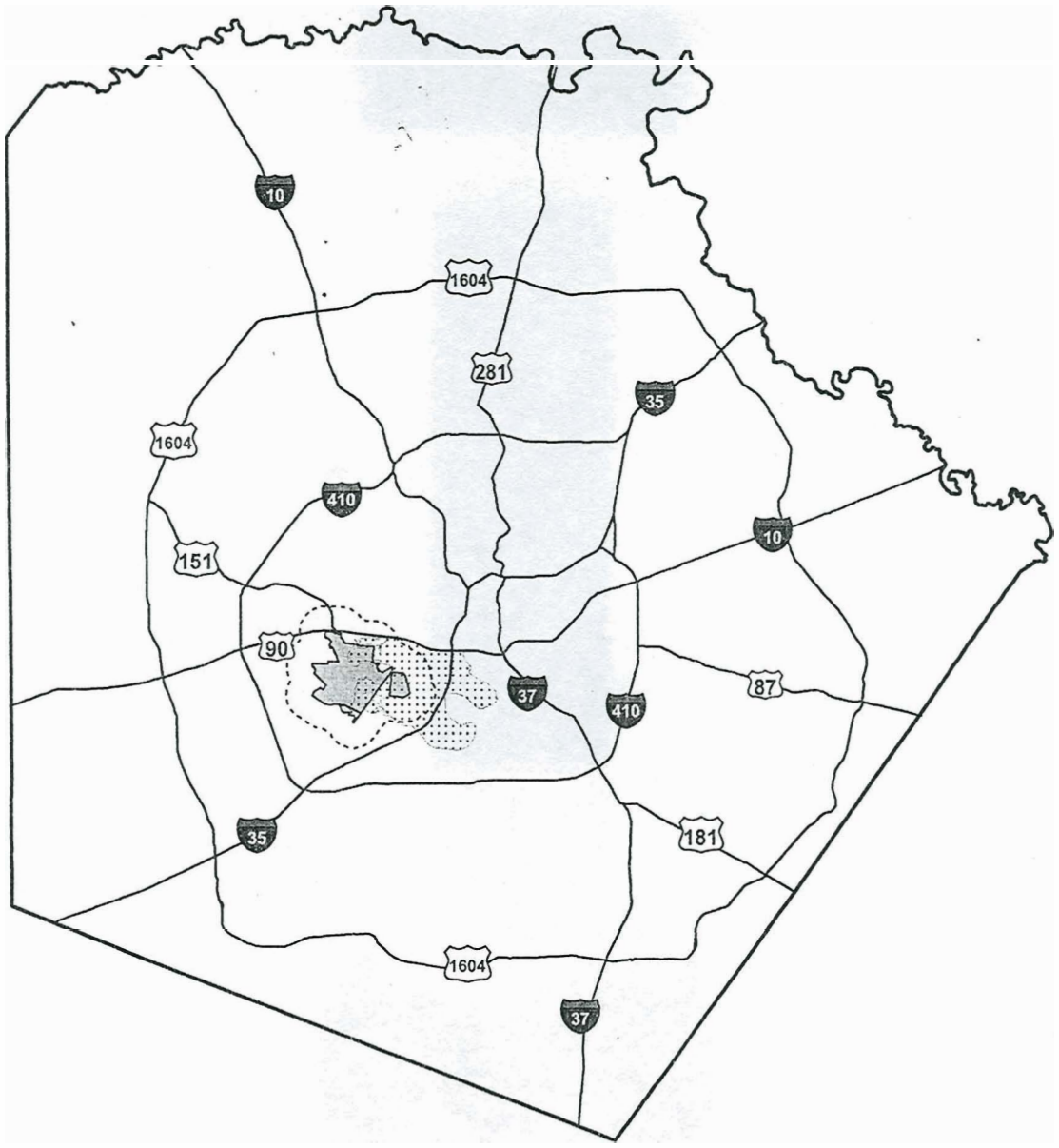
Agenesis, aplasia, or hypoplasia of the lung The absence or incomplete development of a lung or lung tissue.

Down syndrome (Trisomy 21) The chromosomal abnormality characterized by an extra copy of chromosome 21. Down syndrome is characterized by moderate to severe mental retardation, sloping forehead, small ear canals, flat bridged nose, and short fingers and toes.

Pyloric stenosis A narrowing of the pyloric sphincter at the outlet of the stomach. This causes a blockage of food from the stomach into the small intestine. Usually treated surgically.

Tricuspid valve atresia or stenosis A congenital cardiac condition characterized by the absence or constriction of the tricuspid valve. The opening between the right atrium and right ventricle is absent or restricted, and normal circulation is not possible. This condition is surgically corrected depending on the severity.

Figure 1. Bexar County, Texas



Major Highways

Water Plume

Kelly AFB

One Mile Buffer around Kelly AFB

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TABLE 1. CRUDE AND ADJUSTED PREVALENCE RATIOS FOR LIVING WITHIN ONE MILE OF KELLY AIR FORCE BASE.
Statistically significant results are in bold.

Defect	NUMBER OF CASES		CRUDE RESULTS			ADJUSTED RESULTS		
	Within 1 Mile	Not	Prev Ratio	LCL	UCL	Prev Ratio	LCL	UCL
Anencephaly	2	21	1.88	0.14 -	8.83	1.31	0.10 -	6.14
Spina bifida	3	38	1.56	0.21 -	5.62	1.57	0.12 -	7.31
Encephalocele	1	13	1.52	0.02 -	11.36	1.87	0.20 -	7.86
Microcephaly	5	58	1.70	0.40 -	4.80	1.72	0.49 -	4.43
Holoprosencephaly	2	10	3.95	0.27 -	21.76	3.38	0.71 -	11.28
Hydrocephaly	4	77	1.02	0.20 -	3.11	0.97	0.27 -	2.50
Anophthalmia	0	3	0.00			0.00		
Microphthalmia	3	37	1.60	0.22 -	5.79	1.62	0.45 -	4.23
Cataract	0	13	0.00			0.00		
Aniridia	0	0	0.00			0.00		
Anotia or microtia	3	30	1.97	0.27 -	7.30	2.05	0.80 -	4.37
Common truncus	2	12	1.52	0.02 -	11.36	1.31	0.03 -	8.77
Transposition of the great vessels	7	56	2.47	0.74 -	6.18	2.79	0.98 -	6.50
Tetralogy of Fallot	1	39	0.51	0.01 -	3.31	0.48	0.02 -	2.36
Ventricular septal defect	17	497	0.67	0.33 -	1.20	0.71	0.43 -	1.10
Atrial septal defect	14	282	0.98	0.44 -	1.86	0.98	0.41 -	1.97
Endocardial cushion defect	3	38	1.56	0.21 -	5.62	1.79	0.45 -	4.93
Pulmonary valve atresia/stenosis	1	74	0.27	0.00 -	1.69	0.29	0.05 -	0.86
Tricuspid valve atresia/stenosis	5	38	2.60	0.60 -	7.59	***3.05***	***1.26 -***	***6.34***
Ebstein anomaly	1	13	1.52	0.02 -	11.36	1.41	0.11 -	6.58
Aortic valve stenosis	1	26	0.76	0.01 -	5.14	0.81	0.07 -	3.31
Hypoplastic left heart syndrome	1	20	0.99	0.01 -	6.88	1.38	0.10 -	6.23
Patent ductus arteriosus	31	558	1.10	0.66 -	1.71	1.20	0.84 -	1.66
Coarctation of the aorta	2	48	0.82	0.06 -	3.56	0.94	0.22 -	2.59
Choanal atresia/stenosis	0	11	0.00			0.00		
Agenesis/aplasia/hypoplasia of lung	8	58	2.72	0.89 -	6.51	***2.30***	***1.11 -***	***4.77***
Cleft palate alone	2	58	0.68	0.05 -	2.91	0.71	0.03 -	3.62
Cleft lip with/without cleft palate	6	119	0.99	0.27 -	2.53	1.08	0.28 -	2.84
Tracheoesophageal fistula / esophageal atresia	0	28	0.00			0.00		
Pyloric stenosis	24	230	***2.06***	***1.13 -***	***3.45***	1.89	0.99 -	3.28

Defect	NUMBER OF CASES Within 1 Mile	Not	CRUDE RESULTS Prev Ratio	LCL	UCL	ADJUSTED RESULTS Prev Ratio	LCL	UCL
Stenosis/atresia of small intestine	0	33	0.00			0.00		
Stenosis/atresia of large intestine, rectum, or anus	4	50	1.58	0.30 -	4.92	1.38	0.05 -	8.24
Hirschsprung disease	0	12	0.00			0.00		
Biliary atresia	1	14	1.41	0.02 -	10.40	1.10	0.01 -	9.75
Hypospadias or epispadias	12	303	0.78	0.33 -	1.54	0.88	0.40 -	1.66
Renal agenesis/dysgenesis	4	55	1.43	0.27 -	4.44	1.36	0.44 -	3.26
Obstructive genitourinary defect	8	213	0.74	0.25 -	1.67	0.74	0.13 -	2.34
Bladder extrophy	0	3	0.00			0.00		
Congenital hip dislocation	4	43	1.84	0.35 -	5.79	1.99	0.27 -	7.46
Reduction defects of the upper limbs	4	49	1.61	0.30 -	5.03	1.50	0.53 -	3.38
Reduction defects of the lower limbs	2	26	1.52	0.11 -	6.93	1.79	0.37 -	5.50
Craniosynostosis	0	34	0.00			0.00		
Diaphragmatic hernia	4	28	2.82	0.52 -	9.31	2.34	0.90 -	5.13
Omphalocele	0	28	0.00			0.00		
Gastroschisis	2	39	1.01	0.07 -	4.44	0.49	0.07 -	1.69
Down syndrome (trisomy 21)	6	143	0.83	0.23 -	2.09	0.94	0.40 -	1.87
Patau syndrome (trisomy 13)	0	16	0.00			0.00		
Edwards syndrome (trisomy 18)	2	29	1.36	0.10 -	6.14	2.90	0.33 -	12.46
Fetal alcohol syndrome and related defects	0	5	0.00			0.00		
Any monitored birth defect	194	3696	1.04	0.85 -	1.25	1.07	0.91 -	1.24

TABLE 2. A CLOSER LOOK AT DISTANCE FROM THE BORDERS OF KELLY AIR FORCE BASE. Statistically significant results are in bold.

			CRUDE RESULTS				ADJUSTED RESULTS			
Defect	**Distance of Residence to Border of Kelly AFB**	**Number of Cases**	**Prev Ratio**	**LCL**	**UCL**	**p Value for Trend**	**Prev Ratio**	**LCL**	**UCL**	**p Value for Trend**
Tricuspid valve atresia/stenosis	1/2 mile or less	2	2.27	0.17	9.97	0.11	2.63	0.56	7.69	0.03
	Greater than 1/2 to 1 mile	3	2.88	0.39	10.39		3.41	1.00	8.67	
	Greater than 1 mile	38	1.00	(referent)			1.00	(referent)		
Agenesis/aplasia/hypoplasia of lung	1/2 mile or less	4	***2.97***	***0.56***	***9.15***	***0.00***	Not able to estimate			
	Greater than 1/2 to 1 mile	4	***2.51***	***0.48***	***7.75***					
	Greater than 1 mile	58	***1.00***	***(referent)***						
Pyloric stenosis	1/2 mile or less	12	***2.25***	***0.95***	***4.46***	***0.00***	2.09	0.86	4.22	0.01
	Greater than 1/2 to 1 mile	12	***1.90***	***0.80***	***3.77***		1.72	0.71	3.49	
	Greater than 1 mile	230	***1.00***	***(referent)***			1.00	(referent)		

TABLE 3. CRUDE AND ADJUSTED PREVALENCE RATIOS FOR RESIDENCES OVER THE REPORTED PLUME OF GROUNDWATER CONTAMINATION.
Statistically significant results are in bold.

Defect	NUMBER OF CASES		CRUDE RESULTS			ADJUSTED RESULTS		
	Over Plume	Not	Prev Ratio	LCL	UCL	Prev Ratio	LCL	UCL
Anencephaly	4	19	3.23	0.58	11.34	0.98	0.07	4.70
Spina bifida	1	40	0.38	0.01	2.50	0.37	0.01	1.96
Encephalocele	2	12	2.55	0.18	13.38	3.33	0.91	9.57
Microcephaly	6	57	1.61	0.44	4.26	1.60	0.31	5.24
Holoprosencephaly	0	12	0.00			0.00		
Hydrocephaly	5	76	1.01	0.24	2.80	0.92	0.30	2.15
Anophthalmia	0	3	0.00			0.00		
Microphthalmia	5	35	2.19	0.50	6.46	2.29	0.85	5.21
Cataract	0	13	0.00			0.00		
Aniridia	0	0	0.00			0.00		
Anotia or microtia	1	32	0.48	0.01	3.18	0.48	0.07	1.57
Common truncus	2	12	2.55	0.18	13.38	2.18	0.31	8.85
Transposition of the great vessels	3	60	0.77	0.11	2.68	0.85	0.12	3.00
Tetralogy of Fallot	2	38	0.81	0.06	3.55	0.72	0.10	2.51
Ventricular septal defect	29	485	0.92	0.54	1.45	0.96	0.65	1.36
Atrial septal defect	20	276	1.11	0.58	1.93	1.10	0.56	1.97
Endocardial cushion defect	4	37	1.66	0.31	5.30	1.92	0.59	4.89
Pulmonary valve atresia/stenosis	2	73	0.42	0.03	1.78	0.45	0.12	1.13
Tricuspid valve atresia/stenosis	2	41	0.75	0.06	3.27	0.85	0.23	2.22
Ebstein anomaly	1	13	1.18	0.02	8.83	1.05	0.09	4.80
Aortic valve stenosis	3	24	1.92	0.25	7.29	2.16	0.65	5.61
Hypoplastic left heart syndrome	1	20	0.77	0.01	5.35	1.16	0.09	5.34
Patent ductus arteriosus	39	550	1.09	0.69	1.62	1.20	0.88	1.61
Coarctation of the aorta	2	48	0.64	0.05	2.76	0.72	0.17	2.00
Choanal atresia or stenosis	1	10	1.53	0.02	12.19	1.21	0.16	4.65
Agenesis, aplasia, or hypoplasia of the lung	7	59	1.82	0.55	4.54	1.00		
Cleft palate alone (without cleft lip)	7	53	2.02	0.61	5.10	2.25	0.68	5.82
Cleft lip with or without cleft palate	6	119	0.77	0.21	1.96	0.84	0.21	2.26
Tracheoesophageal fistula / esophageal atresia	0	28	0.00			0.00		
Pyloric stenosis	22	232	1.45	0.78	2.48	1.29	0.68	2.22

Defect	NUMBER OF CASES Over Plume	Not	CRUDE RESULTS Prev Ratio	LCL	UCL	ADJUSTED RESULT: Prev Ratio	LCL	UCL
Stenosis or atresia of the small intestine	0	33	0.00			0.00		
Stenosis or atresia of the large intestine, rectum, or anus	5	49	1.56	0.36 -	4.47	1.33	0.09 -	6.92
Hirschsprung disease	0	12	0.00			0.00		
Biliary atresia	0	15	0.00			0.00		
Hypospadias or epispadias	16	299	0.82	0.39 -	1.50	1.06	0.56 -	1.84
Renal agenesis or dysgenesis	5	54	1.42	0.33 -	4.02	1.32	0.44 -	3.13
Obstructive genitourinary defect	11	210	0.80	0.32 -	1.64	0.71	0.19 -	1.87
Bladder exstrophy	0	3	0.00			0.00		
Congenital hip dislocation	4	43	1.43	0.27 -	4.50	1.57	0.44 -	4.12
Reduction defects of the upper limbs	5	48	1.60	0.37 -	4.57	1.46	0.53 -	3.29
Reduction defects of the lower limbs	3	25	1.84	0.25 -	6.96	2.36	0.50 -	7.64
Craniosynostosis	4	30	2.04	0.38 -	6.69	2.90	0.89 -	7.51
Diaphragmatic hernia	2	30	1.02	0.07 -	4.59	0.80	0.14 -	2.61
Omphalocele	2	26	1.18	0.09 -	5.38	1.15	0.26 -	3.37
Gastroschisis	2	39	0.79	0.06 -	3.45	0.37	0.05 -	1.32
Trisomy 21 (Down syndrome)	16	133	1.84	0.87 -	3.45	***1.97***	***1.16*** -	***3.17***
Trisomy 13 (Patau syndrome)	0	16	0.00			0.00		
Trisomy 18 (Edwards syndrome)	2	29	1.06	0.08 -	4.77	2.21	0.25 -	9.89
Fetal alcohol syndrome or other alcohol related birth defects	0	5	0.00			0.00		
Infants and fetuses with any monitored birth defect	242	3648	1.02	0.85 -	1.20	1.03	0.89 -	1.18

TABLE 4. RESIDENCE WITHIN A MILE OF KELLY AIR FORCE BASE AND IN THE REPORTED PLUME OF GROUNDWATER CONTAMINATION. Statistically significant results are in bold.

Defect and Statistical Model	Exposure Group	Number of Cases *	Crude p value	Adjusted p value
Tricuspid valve atresia/stenosis				
Model with main effects only	Living within 1 mile	5	0.02	***0.00***
	Living over the plume	2	0.13	0.02
	Neither	38		
Model with combined term	Both within 1 mile and over plume	2	not able to	not able to
	Living within 1 mile	5	estimate	estimate
	Living over the plume	2		
	Neither	38		
Agenesis/aplasia/hypoplasia of the lung				
Model with main effects only	Living within 1 mile	8	0.18	not able to
	Living over the plume	7	0.84	estimate
	Neither	57		
Model with combined term	Both within 1 mile and over plume	6	0.05	not able to
	Living within 1 mile	8	0.89	estimate
	Living over the plume	7	0.12	
	Neither	57		
Pyloric stenosis				
Model with main effects only	Living within 1 mile	24	0.32	0.01
	Living over the plume	22	0.95	0.86
	Neither	216		
Model with combined term	Both within 1 mile and over plume	8	0.10	0.09
	Living within 1 mile	24	0.55	0.31
	Living over the plume	22	0.01	0.01
	Neither	216		

Defect and Statistical Model	Exposure Group	Number of Cases *	Crude p value	Adjusted p value
Down syndrome (trisomy 21)				
Model with main effects only	Living within 1 mile	6	0.02	0.02
	Living over the plume	16	***0.00***	***0.00***
	Neither	132		
Model with combined term	Both within 1 mile and over plume	5	0.09	0.02
	Living within 1 mile	6	0.02	***0.00***
	Living over the plume	16	0.49	0.30
	Neither	132		

* Note: Categories are not mutually exclusive; cases who live both within 1 mile and over the plume are counted as living within 1 mile and counted again as living over the plume.